DOCUMENT RESUME

ED 284 193 CS 008 890

AUTHOR Afflerbach, Peter
TITLE The Influence of Prior Knowledge on Expert Readers' Main Idea Construction Processes. Outstanding Dissertation Monograph, 1986.
INSTITUTION International Reading Association, Newark, Del.
REPORT NO ISBN-0-87207-492-7
PUB DATE 87
NOTE 50p.; Ph.D. Dissertation, State University of New York at Albany, August 1985.
AVAILABLE FROM International Reading Association, 800 Barksdale Rd., Newark, DE 19714-8139 (Book No. 494, $5.00 member, $7.00 nonmember).
PUB TYPE Dissertations/Theses - Doctoral Dissertations (041) -- Reports - Research/Technical (143)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Higher Education; *Prior Learning; Protocol Analysis; Psycholinguistics; Reader Text Relationship; *Reading Comprehension; *Reading Processes; Reading Research; Reading Skills; *Reading Strategies; Schemata (Cognition); Theory Practice Relationship
IDENTIFIERS *Main Idea

ABSTRACT

A series of three studies examined the influence of prior knowledge on expert readers' main idea construction processes. Eight expert readers read texts from familiar and unfamiliar content domains, and gave verbal reports of the processes they used for constructing main ideas. Five distinct main idea construction processes were reported: (1) initial hypothesis, (2) topic/comment, (3) draft and revise, (4) listing, and (5) automatic main idea construction. A significant interaction was found between main idea construction process type and text familiarity. Results indicated that the relative familiarity of the text topic influences the type of main idea construction process used. The think aloud protocols also allowed examination of the processes used in concert with main idea construction, including importance assignment, hypothesis testing, and comprehension monitoring. The findings imply that teachers should acknowledge the difficulty of the main idea extraction process and model the process for their students. (Three appendixes contain descriptions of texts used in the experiments, instructions given to subjects, and a description of the verbal transcription method. Two pages of references are included.) (SKC)

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Outstanding DISSERTATION monograph 1986

The Influence of Prior Knowledge on Expert Readers' Main Idea Construction Processes

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Outstanding DISSERTATION monograph 1986

The Influence of Prior Knowledge on Expert Readers' Main Idea Construction Processes

Peter Afflerbach
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Dissertation Completed at
State University of New York at Albany
August 1985

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ISBN 0-87207-492-7

CONTENTS

Acknowledgments iv
Introduction v
Abstract vi
The Effects of Prompts on Verbal Report Latencies 3
The Influence of Prior Knowledge on Expert Readers' Main Idea Construction Processes 9
A Qualitative Analysis of Expert Readers' Protocol Data: Processes Related to Main Idea Construction 19
General Conclusions 31
Limitations 33
Educational Implication 35
Appendix A 37
Appendix B 41
Appendix C 42
References 42

ACKNOWLEDGMENTS

I would like to thank my dissertation committee members Dick Allington and Fred Ohnmacht for the suggestions, insights and constructive criticism they provided, and the good humor which tempered their remarks. I would also like to thank the expert readers who participated in the study, and the SUNY/Albany Benevolent Association for the award which provided payment for the subjects and materials. A special thanks to the chair of my dissertation committee, Peter Johnston. The quality of his friendship and support are matched only by his teaching and scholarship. Finally, I would like to thank Wendy Binder for her constant friendship and understanding throughout the entire process.

PA

INTRODUCTION

The purpose of the Outstanding Dissertation of the Year Award is to promote quality in reading research and to recognize young scholars in the field of reading. Besides selecting a winner, the Committee chooses ten finalists who have an opportunity to present their research at the Annual International Reading Association Convention. This gives members of the I.R.A. an annual opportunity to hear presentations of some of the best doctoral research in the field of reading.

For 1987 the Committee has introduced a prize of $1,000 supported by a grant from Ginn and Company to be given each year to the winner. The Committee feels that this will enhance the prestige of the award and will be of practical value to a recipient completing his/her graduate program.

I would like to thank all the applicants who applied for the Outstanding Dissertation of the Year Award for the time and effort they put into writing their proposals. As Chairman of the Committee, I was impressed with the excellent quality of the dissertations submitted. I would also like to thank the members of the Committee for their time and effort expended in the difficult task of selecting the Outstanding Dissertation for 1986. My sincere congratulations are extended to Dr. Peter Afflerbach, the winner of this year's Award.

Lloyd O. Ollila
University of Victoria
British Columbia
Chair, Subcommittee on the Research Award

ABSTRACT

This series of studies examined the influence of prior knowledge on expert readers' main idea construction processes. Eight expert readers read texts from familiar and unfamiliar content domains, and gave verbal reports of the processes they used for constructing main ideas. Five distinct main idea construction processes were reported, and a significant interaction was found between main idea construction process type and text familiarity. Results indicate that the relative familiarity of the text topic influences the type of main idea construction process used. The think aloud protocols also allowed examination of the processes used in concert with main idea construction, including importance assignment, hypothesis testing, and comprehension monitoring. Additionally, readers' affective interaction with the author and the text is considered. Implications of findings for theoretical models of reading comprehension and comprehension instruction are considered.

The Influence of Prior Knowledge on Expert Readers' Main Idea Construction Processes

Constructing a main idea from text is one of the most important and difficult reading comprehension skills (Brown & Day, 1983; Pearson & Johnson, 1978; van Dijk & Kintsch, 1983). It is the most frequently mentioned skill in reading series and reading textbooks (Johnson & Barrett, 1981). Research indicates that the ability to construct a main idea (when it is not explicitly stated in the text) is a late developing skill for many readers, and a skill that is lacking in others (Brown & Day, 1983; Garner, 1982). However, we know relatively little about the processes involved in main idea construction (Goetz & Armbruster, 1980; Winograd & Bridge, 1986).

Brown and Day (1983) had little success in teaching students to construct main ideas, though it was a critical step in summarization training. These researchers noted that main idea construction is problematic for the majority of readers, but the less able the reader, the more difficult the construction task.

How do good readers *construct* main idea statements? Brown and Day (1983) asked expert summarizers, and experts appeared to construct main ideas in one elemental step, as their verbal reports were lacking any mention of component strategies. Van Dijk and Kintsch's model of the reading process (1983; Kintsch & van Dijk, 1978) and related work (e.g., Kieras, 1981; 1982) also present main idea construction as an automatic, elemental process. An alternative conceptualization of the main idea construction task was proposed by Johnston and Afflerbach (1985). Following Ericsson & Simon (1984), they suggest that although verbal reports have been useful in investigating comprehension processes such as summarization, when the process to be examined is automatic, verbal reports may not yield information. Automatic processess by-pass working memory, and hence, are not available for verbal reporting. The resulting problem is that while it is important to determine how expert readers construct main ideas, these are the very readers who are most likely to have automated the process. This may have occurred in the Brown and Day (1983) study, as the readers most able to construct main idea statements were graduate students reading texts of fifth grade difficulty.

Johnston and Afflerbach (1985) used difficult texts to de-automate expert readers' main idea construction processes and make them available for verbal reporting. The rationale for using difficult text was based in part on studies of inner speech during problem solving and reading (Edfelt, 1960; Sokolov, 1972). These studies demonstrate that inner speech increases with more difficult tasks. Johnston and Afflerbach's study involved proficient readers providing verbal reports while reading texts which had no topic sentences (hence readers were required to construct them), and which were very difficult.

That study identified five processes for constructing main idea statements. Four of these processes were de-automated (initial hypothesis, topic/comment, draft and revise, listing), while the fifth was automated. The five main idea construction processes served to specify the more general construction rule of Brown and Day (1983).

Johnston and Afflerbach's exploratory study included two design features of importance to the present studies. First, the verbal reporting methodology required that subjects' tasks be difficult enough to de-automate their reading processes, making them available in working memory for reporting. To accomplish this, texts that were difficult, and for the most part unfamiliar, were used. Thus, it was not possible to examine the effects of prior knowledge on main idea construction processes. Second, the purpose of the study was to determine how expert readers constructed main ideas. This involved qualitative analysis of the protocols, and frequency of use of the different main idea construction processes was not investigated.

The series of studies reported in this paper examines, through verbal reports, the processes used by expert readers when constructing main ideas from familiar and unfamiliar text. It is assumed that reading is an interactive process (Rumelhart, 1977), and that main idea construction processes are likely to vary depending on the relationship between the reader and the text. One parameter of this reader/text relationship which has been extensively examined, and in which results have been well-documented is prior knowledge (Anderson & Pearson, 1984; Bartlett, 1932; Chiesi, Spilich & Voss, 1979; Johnston, 1984). While it has been established that prior knowledge can influence comprehension of text, this interaction has often been examined through use of product measures, such as scores on comprehension tests. The major purpose of the present study is to examine the influence of prior knowledge on expert readers' main idea construction processes.

Three related studies are reported. The first experimental study focusses on the verbal reporting methodology, and examines the effects of the use of prompts, or reminders to report, on subjects' verbal reporting behavior. Study Two examines the influence of prior knowledge on expert readers' main idea construction processes. Study Three describes readers' processes related to main idea construction.

STUDY ONE
The Effects of Prompts on Verbal Report Latencies

The verbal report methodology in reading research has a lengthy, though sporadic history (e.g., Huey, 1908; Piekarz, 1954; Olshavsky, 1976-77; Scardamalia & Bereiter, 1984). The method has been controversial (Ericsson & Simon, 1984), and lengthy justification of it cannot be undertaken here. For discussion of the potential benefits and limitations of the verbal reporting methodology, the reader is referred to Afflerbach and Johnston (1984), Ericsson and Simon (1984), and Hayes and Flower (1983).

Studies Two and Three involve the use of verbal reports to examine main idea construction processes for familiar and unfamiliar text. This requires that the readers have access to their cognitive processes, which under some conditions might be automated. While de-automation would be expected to happen naturally with difficult reading tasks (Edfelt, 1960; Hardyck & Petrinovich, 1970), it was not clear that expert readers would have access to their main idea construction processes while reading texts from a familiar content domain. Accordingly, it was necessary to use prompts set in the text to guarantee verbal reports.

It has not been ascertained whether or not such prompts, rather than reminding subjects to report the contents of working memory, merely prompt subjects to reconstruct a description of what probably happened, which would diminish the validity of the reports. The first study is based on the premise that the reconstruction of a description would presumably take time, and would be reflected in the latencies of the verbal reports following the prompts. Thus, Study One compared the latencies of prompted and unprompted reports given by an anthropology doctoral student and a chemistry doctoral student on familiar and unfamiliar texts, using a series of repeated measures analyses of variance.

Method

Subjects

An anthropology doctoral student and a chemistry doctoral student were recruited from a large, northeastern state university. Doctoral student status was used as a proxy for expert reader status. Selection procedures,

which included a pre-experiment questionnaire and interview, resulted in two subjects (one anthropology, one chemistry) who were expert readers, with relatively high content domain knowledge for the text from their special field, relatively low prior knowledge for the text from the unfamiliar field, and who were naive to the literature on text processing, reading comprehension, and cognitive psychology.

Materials.

The texts used in Study One were from the content domains of anthropology (text A) and chemistry (text B). Both texts were excerpts from professional journal articles, and were taken from the literature review sections of each article. Texts were of similar length (text A: 596 words; text B: 590 words), and each consisted of 5 paragraphs. The topic of text A was the evolution of American indian arrowheads (Turnbaugh, 1975), while the topic of text B was the organic origins of petroleum (Blumer, 1973). Neither text contained any paragraph-level or text-level main idea statements, thus requiring readers to construct (and not select) main idea statements. (See Appendix A).

Intersentence visual prompts for reporting (red dots) were inserted in alternate paragraphs. For example, the first, third and fifth paragraphs of the anthropology text read by the anthropology subject included prompts, while the second and fourth paragraphs did not. Placement of prompts was thus counterbalanced across text type (familiar/unfamiliar) and across subjects.

Procedure

One week prior to participating in the experiment, the expert readers were asked to reflect on the processes they used while reading. This served to help familiarize them with the task of thinking about, and reporting, reading behaviors. An additional orientation procedure was used: immediately prior to the experimental think-aloud sessions, subjects were given practice texts and asked to report on their mental processes while reading. Subjects then read each text aloud, and reported on the processes they used to construct main idea statements. Verbal reports were recorded using a cassette tape recorder. The verbal report latencies were recorded in three conditions: prompted intersentence, unprompted intersentence, and unprompted intrasentence.

Results

Latency data were analyzed using a 2 X 3 repeated measures ANOVA. The independent variables were text familiarity (familiar/unfamiliar), and condition under which the verbal report latency was recorded (prompted intersentence/unprompted intersentence/unprompted intrasentence). The dependent variable was mean response latency. Descriptive statistics for this analysis are presented in Table 1.

Table 1 Descriptive Statistics for Study One: Verbal Report Latencies

Familiar Text			
	Prompted intersentence	*Unprompted intersentence*	*Unprompted intrasentence*
X	2.79	2.13	3.24
s.d.	.97	.40	.39
Unfamiliar Text			
	Prompted intersentence	*Unprompted intersentence*	*Unprompted intrasentence*
X	2.75	2.76	3.64
s.d.	1.09	.39	1.72

Results of the repeated measures ANOVA are presented in Table 2. This analysis yielded no significant main effects for text familiarity, $F(1,1) = 1 > F$, or for prompt status, $F(2,2) = 1 > F$. The interaction of text familiarity and prompt status yielded an $F(2,2) = 1 > F$.

Table 2 Analysis of variance table 2 X 3 Text Familiarity X Prompt Status

	SS	df	MS	F	Prob
Mean	99.648	1	99.648	1105.56	.02
Familiarity	0.327	1	0.327	.26	.70
Error	1.281	1	1.281		
Prompt status	2.048	2	1.024	.70	.58
Error	2.911	2	1.455		
Familiarity X Prompt status	0.225	2	0.113	.18	.84
Error	1.254	2	0.627		

A second repeated measures ANOVA was performed, with outliers (those latencies more than three standard deviations from the mean pause time for a particular condition) removed from the analysis. All of the removed outliers were three or more standard deviations above the mean. The descriptive statistics for this analysis are presented in Table 3.

Table 3 Descriptive Statistics for Study One: Verbal Report Latencies Adjusted Data With Outliers Removed

Familiar Text			
	Prompted intersentence	*Unprompted intersentence*	*Unprompted intrasentence*
X	2.22	1.26	2.30
s.d.	1.04	.22	.51
Unfamiliar Text			
	Prompted intersentence	*Unprompted intersentence*	*Unprompted intrasentence*
X	2.22	2.28	3.48
s.d.	.34	.28	1.48

The second ANOVA (Table 4) yielded no main effects for text familiarity $F(1,1) = 2.01$, $p > .39$, or for prompt status, $F(2,2) = 1.84$, $p > .35$. The interaction of text familiarity and prompt status yielded an $F, 1 > F$. Because the omnibus F was not significant in either analysis, further analyses were not performed. Nonetheless, there was not even a trend in the anticipated direction. Indeed, the pause time cell means were generally in the opposite direction of the automatization/reconstruction effect that might have posed a threat to the validity of the study. It is acknowledged that due to the small number of degrees of freedom, the analyses may have been limited in their sensitivity to some effects.

Table 4 Analysis of variance table 2 X 3 Text Familiarity X Prompt Status Adjusted Data With Outliers Removed

	SS	df	MS	F	Prob
Mean	62.975	1	62.975	1788.64	.02
Familiarity	1.621	1	1.621	2.01	.39
Error	1.281	1	1.281		
Prompt status	2.564	2	1.282	2.84	.35
Error	1.393	2	0.697		
Familiarity X Prompt status	0.812	2	0.406	.52	.65
Error	1.549	2	0.775		

Discussion

The immediate concern of Study 1 was the effect of prompts on subjects' verbal report latencies. If significant differences were found in prompted and unprompted latencies, then there would be a threat to the validity of the reports. For example, if the latencies were greater in the familiar text/prompt condition, it might be argued that the readers were reconstructing descriptions of automated processes which had actually by-passed working memory (Ericsson & Simon, 1984), rather than reporting the processes used to construct main ideas as they occurred in working memory.

No significant differences were found in the latencies under any of the experimental conditions. These results are interpreted as indicating that subjects' verbal reports are equivalent, in terms of the memory system conditions under which they were reported. According to the verbalization model of Ericsson and Simon (1984), when the prompts were heeded, the verbalizations reported the contents of working memory, rather than processes which had to be reconstructed from memory. Recall that this was a particular concern in the prompt/familiar text condition, where the possibility existed that the subjects' automated processes would by-pass working memory, and thus would have to have been reconstructed from memory to be reported. Note also that the subjects for this study (as well as for Studies Two and Three) were chosen in part for their naive status in regards to cognitive psychology and text processing literature. Thus, it is improbable that subjects could have been reconstructing their reports from any prior knowledge of a specific theory of reading comprehension.

The findings of Study One have important implications for Studies Two and Three. Reports given in the prompt/familiar text condition will be considered similar in nature and origin to those given in the other conditions. Because of the lack of power in Study One, it is noted that a study of verbal report latencies which uses increased numbers of subjects would be a helpful next step.

STUDY TWO
The Influence of Prior Knowledge on Expert Readers' Main Idea Construction Processes

This second study examined the effects of different levels of content domain prior knowledge on expert readers' main idea construction processes.

Method

Subjects.

The subject selection procedures for Study Two were identical to those of Study One, and resulted in a pool of eight (four anthropology, four chemistry) expert reader subjects.

Materials.

The texts used for Study Two were identical to those used in Study One, except that visual prompts for reporting (red dots) were inserted at the end of every sentence and paragraph.

Tasks.

The orientation procedures and instructions to subjects were identical to those of Study One, except that subjects were asked to report at the red markers which followed every sentence and paragraph (see Appendix B). For Study Two, the transcribed think-aloud protocols yielded 210 pages of verbal report data for the eight subjects.

Results

Data analysis began with examination of the verbal report protocols, and identification of the main idea construction processes, according to the classification scheme developed by Johnston and Afflerbach (1985). For this study, a main idea statement had to meet the requirement of consisting of a topic and a comment. Main idea construction processes were classified in five categories: 1) initial hypothesis, in which the reader predicted the topic of the text at the beginning of reading the text; 2) draft and revise, in which the reader made a rough draft main idea statement upon finishing the text, and then returned to the text to refine the draft; 3) topic/comment, in

which the reader finished reading the text and stated the topic, and then returned to the text to find a comment for the topic; 4) listing, in which the reader skimmed or searched the text, looking for related words and concepts to comprise the main idea statement; and 5) an automated main idea construction process, for which no reports of processing were given, though the main idea statements themselves were given.

To establish coding reliabilities, fifteen instances of each process were randomly selected from the protocols, and read aloud to a second coder, using a transcription scheme developed for this study (see Appendix C). Interrater agreement was determined for the five categories of main idea construction process. Across the 75 excerpts, coding reliabilities were as follows: automatic main idea construction 100%, initial hypothesis 87%; draft and revise 93%; topic/comment 87%; and listing 100%. Discussions between the coders resolved the disagreements in categorization. Next, the frequencies of the main idea construction processes used in familiar and unfamiliar text, and by anthropology and chemistry subjects, were determined. The frequencies of main idea construction processes are presented in Table 5.

A 2 X 2 X 5 mixed model, repeated measures ANOVA (Winer, 1971) in which the factors were subject major (between subjects), text familiarity, or prior knowledge (within subjects) and main idea construction process (within subjects) was performed. Subject major was anthropology or chemistry, text familiarity was familiar or unfamiliar, and main idea construction processes were automatic main idea construction, initial hypothesis, draft and revise, topic/comment, and listing. Number of occurrences of specific main idea construction process was the dependent variable. The epsilon statistic (Greenhouse & Geisser, 1959) was calculated to estimate the data's degree of deviance from the assumption of sphericity, and to adjust accordingly the denominator and numerator degrees of freedom. The epsilon statistic was used because subjects were naive to the verbal reporting methodology, as they were to the literature on text processing and cognitive psychology. Thus, it was possible that once verbal reporting had begun, subjects might fall into a cadence of repeatedly reporting the same processes. The epsilon statistic served as a check on the sphericity, or variance of the distribution of subjects' reported construction processes in this a repeated measures design. With the epsilon adjustment of degrees of free-

Table 5 Frequency of Main Idea Construction Process Used

	Automatic	*Draft and Revise*	*Listing*	*Topic/comment*	*Initial Hypothesis*
Text					
Familiar	24	16	7	7	12
Unfamiliar	6	31	8	10	9

Table 6 Analysis of Variance 2 X 2 X 5 Subject Major X Text Familiarity X Main Idea Construction Process Type

	SS	df	MS	F
Mean	195.384	1	195.384	1942.06
Major	0.505	1	0.505	5.02
Error	0.604	6	0.101	
Familiarity	0.005	1	0.005	0.08
Familiarity X Major	0.010	1	0.010	0.17
Error	0.352	6	0.059	
Process	3.278	4	0.819	2.72
Process X Major	0.861	4	0.215	0.71
Error	7.227	24	0.301	
Familiarity X Process	2.739	4	0.685	4.47*
Familiarity X Process X Major	0.362	4	0.091	0.59
Error	3.673	24	0.153	

* p .lt .04 with Greenhouse-Gesser adjustment

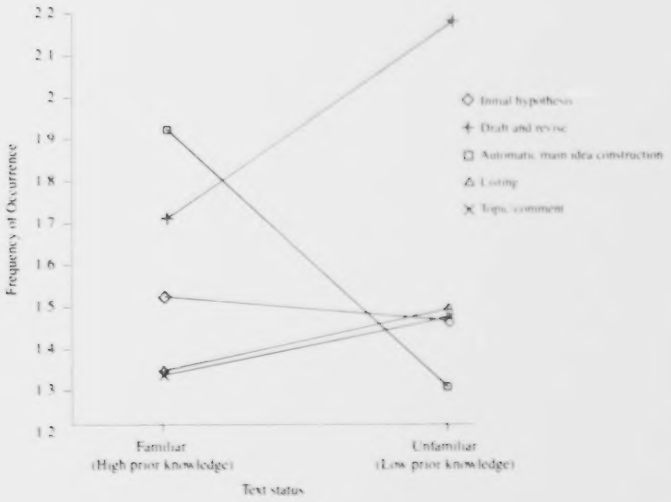
dom, the 2 X 2 X 5 ANOVA yielded no significant main effects for major, text familiarity, or main idea construction process. A significant interaction was found for text familiarity X main idea construction process, $F(4, 24) = 4.47$, $p < .04$ (see Table 6).

Bonferroni t-tests were performed on the cell means for the automated main idea construction process and the draft and revise process, in the familiar and unfamiliar conditions. Results indicated a significant difference in the use of the automatic construction process in the familiar and unfamiliar text conditions, $(t\ 24) = 5.92$, $p < .01$. A significant difference was also found for use of the draft and revise process in familiar and unfamiliar texts, $(t\ 24) = 3.35$, $p < .01$. The cell means plot of the significant interaction is presented in Figure 1.

Discussion

Discussion of the findings of Study Two, the influence of prior knowledge on main idea construction processes, will be as follows: first, the verbal report transcription method will be presented; second, each of the five main idea construction processes will be considered separately: the rule for using the specific main idea construction process under consideration will be given, and an example of the process, taken from the protocols, will be presented. Next, the use of the process in relation to high and low prior knowledge will be considered. Following these is a discussion of the signif-

Figure 1
Plot of cell means for frequency of main idea construction process X text familiarity interaction



icant interaction of text familiarity, as determined by readers' prior knowledge, and main idea construction type.

The verbal report transcription method

The results and discussion section of Study Two, and all of Study Three, contain protocol excerpts. Thus, it is necessary to familiarize the reader with the method used in transcribing the think-aloud tapes (See Appendix C). The method was developed in an attempt to preserve features of spoken language which might be lost in a simple transcription, and without whose consideration interpretation of verbal reports might be less accurate. These spoken language features include pause times, inflections, and spoken emphases contained in the verbal reports.

Main idea construction processes

Initial hypothesis

Initial hypotheses were generated by the reader at, or near the beginning of reading a paragraph or text. The rule for use of the initial hypothesis main idea construction process appears to be: If the reader feels a reasonably accurate initial hypothesis of the main idea can be generated, the reader does so, and then proceeds through the text, checking the accuracy of the prediction.

An example of an initial hypothesis is:

> "...so I'm told..in the beginning sentence that this would.. would.. would possibly be about..these changes in views.uhm...this. tells me it's a historical.. article.and.uh. I'll be looking to hear..uh-an exposition of..developments through.time.in-in a particular discipline"

Initial hypotheses were generated using familiar content domain words or text structure to engage appropriate schemata. Readers generated initial hypotheses for both familiar and unfamiliar text, and there was no significant difference in frequency of use of initial hypotheses on familiar or unfamiliar text. Thus, extensive content domain knowledge was not a prerequisite for engaging in initial hypothesis generation.

That subjects with content domain prior knowledge generated initial hypotheses is in accordance with schema theory (Rumelhart, 1980) and models of reading (Collins, Brown & Larkin, 1980; van Dijk & Kintch, 1983; Goodman, 1976), which suggest that use of the appropriate knowledge structure facilitates not only the organization of incoming information, but also the prediction of information to be encountered. For unfamiliar text, it appeared that the expert readers used two categories of cues for generating initial main idea hypotheses. The first cue type was textual, such as the structure of discourse. A second type of cue used readers' content domain schemata, however impoverished it may have been.

The initial hypothesis seemed akin to van Dijk and Kintsch' (1983) "provisional macroproposition", which the reader establishes early in the course of reading a text. An important function of initial hypotheses is that they may help the reader set goals, in this case to verify or modify the predictions that have been made. In schema theory, the generation of an initial hypothesis is assumed made possible through the engagement of readers' schemata, which are called into use with cues such as content domain vocabulary. As the schemata are activated, they may also help set parameters, within which readers may be secure that they are on the "right track", and outside of which the readers may realize the need for alternative strategies.

In summary, lack of prior knowledge, while having qualitative effects on the type of hypothesis generated, did not inhibit expert readers' tendency to hypothesize main ideas at the outset of reading. However, when readers had greater prior knowledge, their predictions were more accurate.

In contrast to initial hypotheses, main idea construction processes were also performed after reading the text. These processes include topic/comment, draft and revise, and listing.

Topic/comment

The rule for using the topic/comment main idea construction process appears to be:

> If upon completion of the text, the reader is only able to state the topic, the reader does so, and then sets about qualifying the topic with a comment.

An example of the topic/comment process is:

> "it's about artifacts (topic) and..and-uh...a..and so I'm- y'know working out this main idea statement...what are they trying to say?..uhm.and this-this leads me back to the idea that it's.about...uh.artifacts.and how we infer group-.behavior from artifacts" (topic/comment)

Topic/comment served to divide the often demanding task of constructing a main idea into two perhaps more manageable subtasks: read the text and derive a topic, and then re-read or skim to derive a comment. Because of the limitations of readers' working memory systems (Baddeley & Hitch, 1974; Britton, Glynn & Smith, 1985), topic/comment proved valuable when cognitive resources were taxed. Use of the topic/comment strategy was fairly consistent on the familiar and unfamiliar texts. Thus, subjects showed no preference for using it relative to text familiarity. Whether it was used on familiar or unfamiliar text, the topic/comment strategy demonstrated expert readers' successful use of a non-automatic main idea construction process.

Draft and revise

A second, two-stage construction process was draft and revise. The rule for which was:

> If the main idea stated is not satisfactory, the reader considers it a first draft and sets about revising it.

For example:

> "they talk about their.their traits and how they relate to the 'resident groups' (draft) as they call them.and-uh.and this piece of data which.indicates a capping of the narrow-stemmed point levels.in these particular areas.so they're talking about the...integration of some people – broadpoint users – within.a particular area" (revision)

For unfamiliar text, draft and revise was by far the most frequent construction process used. The benefit of using draft and revise, as well as the other non-automated main idea construction processes, is that it served to make the often difficult main idea construction task more manageable. Draft and revise did this in two ways. First, readers could return to the text to refine their understanding of the text, and thus refine their main idea for it. Second, it helped readers deal with the limits of working memory. That is, it allowed for a main idea draft to be stated and stored, while subsequent revision processes marked a return to the text to modify the statement. This was achieved through the gathering of additional information deemed important, the deletion of information deemed unimportant, or the re-organization of information already in working memory.

While draft and revise was used significantly more on unfamiliar (than familiar) text, it was also the second most often used strategy for familiar

text. This finding may be interpreted as indicating the relatively difficult nature of the main idea construction task in this experiment, even for familiar text.

Listing

The rule for the listing process appears to be: The reader searches for important or related words, concepts, or ideas, in text or memory, to be used in constructing a main idea. An example of the listing process is:

> (Finishes reading paragraph)
> "and I'm looking for again key words..'buried sediment', 'bacterial activity-'..'partial transformation' and 'biochemical metabolites' (listing).uh..my choice is based on what's gonna tip me off.the material is already in my mind.I can get the material there..what I need is key words to help .bring it back out and the main idea statement for the selection..Treibs..who-was able to diff-to find a differentiation of different biochemicals that occur in oil layers"

The use of listing required that the reader search the text for related words, ideas or concepts, which supplied the raw material for the main idea construction process. Listing was used by readers who had completed reading a paragraph or text, and who were unable to state a main idea. With this realization, the task was to determine the related parts contained in the text, by skimming or re-reading.

There were no significant differences in the use of listing on familiar and unfamiliar texts. It seems possible that high prior knowledge would enhance the ability to determine what related, and important material is. However, it appears readers with low content domain knowledge could depend on text structure cues, or limited use of content cues, to make listing a fruitful strategy.

Automatic main idea construction

In addition to the four de-automated construction processes noted in the protocols, main idea statements were given without any verbal reports of how the statements were constructed. Because of the automatic nature of these construction processes, a description of them, and rules for the use of the processes cannot be offered. An example of the automatic construction process is:

> "so this whole sen-this whole paragraph I think they're just saying that they think that these-these new traditions came about because of migration" (automatic main idea statement)

For familiar text, the automatic main idea construction process was used significantly more often than any of the other construction processes. It was not possible to determine if the automated main idea construction process was a unique main idea construction process, or the automated form of one of the other processes (e.g., topic/comment; draft and revise).

Again, it is the apparently automatic transformation of data into a main idea statement that escapes description in the verbal reports. However, it may be comparable to the macroprocess of construction described by van Dijk and Kintsch (1983), which is assumed to be automatic.

Johnston and Afflerbach (1985) have noted that the automatic main idea construction process can be assisted by the reader. Subjects sometimes reported on their efforts to create an environment in which automatic construction could occur. These reports noted that the readers had stopped reading, and were "sitting back" or "letting things filter down". Such reports are interpreted as expert readers' conscious control of factors which contribute to the use of an unconscious process. Through the use of comprehension monitoring, expert readers could help construct an environment where automatic main idea construction could be performed.

The five main idea construction processes, and the rules for their use have been presented. The rules for main idea construction, and the frequency of use of specific main idea construction processes on familiar and unfamiliar text have several implications for reading comprehension theory. First, this study supports the findings of Johnston and Afflerbach (1985), and refines Brown and Day's (1983) construction rule. This was accomplished by providing specific rules for four de-automated main idea construction processes, and indicating that main idea construction is not always an automatic, elemental process.

The specification of five main idea construction processes refines van Dijk and Kintsch's (1983) model of text comprehension. Like Brown and Day, these authors assume that main idea construction is an elemental process. While the process may be elemental in the automated form, there were many instances where the main idea construction task was de-automated. Van Dijk and Kintsch's model proposed that those comprehension strategies which are not automated, and hence demand cognitive resources, are of limited usefulness. In this study, such conscious strategies were used in the majority of situations, and were successful. Thus, the findings serve to underscore the importance of non-automatic comprehension processes, especially when they may be the only ones available to the reader.

Interaction of text familiarity and main idea construction type

The significant interaction of text familiarity and main idea construction process directly addresses the major question of this study: "What is the influence of prior knowledge on expert readers' main idea construction processes?" Results indicated that prior knowledge has a significant effect on the construction processes used by expert readers. Automatic main idea construction is the most frequently used process of expert readers when they have high content domain prior knowledge for the text. When the text is unfamiliar and content domain prior knowledge is relatively low, expert readers most often use the non-automatic draft and revise strategy. One interpretation of the data is that relatively greater prior knowledge facili-

tates more rapid, automatic processing, while relatively low prior knowledge requires the reader to use more resource-consuming, conscious strategies to construct a main idea statement.

It is important to consider the cognitive context in which the main idea construction processes were performed. As reported later in Study Three, this context includes importance assignment, hypothesis testing, and comprehension monitoring. The efficiency with which these related processes were performed appeared to influence the automatic or non-automatic status of the construction task. For example, even when an accurate initial hypothesis of the main idea was posed, the task remained for the reader to compare the hypothesis with incoming text to verify the accuracy of the prediction. Similarly, automatically constructed main idea statements were preceded by such processes as importance assignment and comprehension monitoring. Thus, in all cases, the reader had to do cognitive work before the final main idea statement was given. It is within the framework of this concept of "work", and models of working memory (Baddeley & Hitch, 1974; Britton, Glynn & Smith, 1985; LaBerge & Samuels, 1974) that the interaction of prior knowledge and main idea construction process may be examined.

Consider the following work, or processes (examples of which were reported in the think-aloud protocols), which expert readers perform to construct accurate main idea statements: first, readers seek a framework for interpreting the text they have begun reading, and the more extensive the prior knowledge, the more quickly and easily an appropriate schema may be accessed (Anderson & Pearson, 1984). If prior knowledge is lacking, then an existing schema will need restructuring to accommodate the unfamiliar text. Once the schema is called up, it is used to interpret the input from text. At one level, the schema helps the reader identify domain specific vocabulary (Spilich, Vesonder, Chiesi, & Voss, 1979). Again, if the reader's schemata do not contain many of the concepts in the text, cognitive resources will have to be allocated to derive meanings.

In addition to helping the reader identify words, the schema helps in determining coreference of text elements, such as related words, phrases and concepts. Prior knowledge also influences the accuracy and efficiency of the assignment of importance in text, which is crucial for the success of the macroprocesses of deletion and generalization (van Dijk & Kintsch, 1983). Also, the schema helps the reader generate inferences concerning the text topic. Thus, prior knowledge may influence many aspects of the reading task, and can effect processing efficiency, depending on the appropriateness and availability of the prior knowledge. If we assume that the reader's on-task behavior, and access to cognitive resources are fairly constant throughout the task, then intermediary events which effect the processing load, and speed of processing may eventually affect the type of main idea construction process used.

Additionally, content domain prior knowledge may lessen the chance of erring in the use of comprehension strategies. For example, there may

be reduced chance of generating inaccurate hypotheses, or of faulty assignments of importance, when the reader is using a well-developed schema to inform these processes. Finally, the more accurate the performance in comprehending the text, the fewer resources must be allocated to fix-up strategies that are prompted by comprehension monitoring, if comprehension monitoring is taking place.

In sum, as the cognitive resources allocated to comprehending the text increase, so does the use of non-automatic main idea construction processes. If comprehension processes prior to main idea construction are not automatic, they will use resources in working memory, and this will leave fewer resources (Baddeley & Hitch, 1974; LaBerge & Samuels, 1974) for accomplishing tasks that may contribute to automatic main idea construction, such as building an accurate macrostructure of text. In the extreme case, the reader may not be able to construct a main idea statement, due to "thrashing" (Britton, Glynn & Smith, 1985), or the overloading of the reader's text processing system. If the reader has appropriate schemta for the text and task at hand, automaticity of processing may be encouraged, leaving more working memory resources to aid in automatic construction of a main idea statement. Thus, there is significantly greater use of the automatic main idea construction on familiar texts, and the draft and revise main idea construction process on unfamiliar texts.

STUDY THREE
A Qualitative Analysis of Expert Readers' Protocol Data: Processes Related to Main Idea Construction

The subjects in Study Two were asked to report the processes they used to construct main idea statements. This resulted in a total of 210 pages of verbal report transcriptions. Many processes related to main idea construction were also reported, including importance assignment, hypothesis testing, and comprehension monitoring. In Study Three, these related processes will be explored through qualitative analysis of protocols. It is noted that Study Three contains a selected sample of verbal reports, those which the researcher felt best illustrated the processes under consideration. Because of the length constraints of this paper, it is impossible to present the entire context in which readers' cognitive processes were performed, as reported in the think-aloud protocols. This presents a problem, as verbal report data can lose their descriptive power when they are abridged or removed from the context in which they were reported. It is hoped that the excerpts used in Study Three retain some of the flavor, and meaning, of the original verbal reports.

Importance Assignment

The assignment of importance to text was crucial for constructing main idea statements. Through the assignment of importance processes, readers organized information, and text was reduced to a more manageable size, as text elements deemed important were retained, while others were excluded. Included in this section is a discussion of cues used to assign importance, the relationship of readers' goals to importance assignment, and readers' conditional assignment of importance. In analyzing the verbal reports, it became apparent that the organization of information and the assignment of importance were tightly interwoven processes. Thus, they are discussed concurrently in this section.

Contextual Knowledge Based Cues Used in Assigning Importance

Relative familiarity with the text topic was an important factor in the determination of importance of text elements. Familiar words served as

cues to help readers access prior knowledge for both familiar text and unfamiliar text. Thus, familiarity of a word or phrase often resulted in it being assigned importance, in that the word or phrase served as a link between the reader's prior knowledge and the text. (Example 1)

(1) "OK what I'm trying to do is here I'm identifying the words that I really know-..for example 'contemporary cultures in the Northeast' so that would be my first guiding point"

For unfamiliar text, readers tried to establish a point of reference for the text so that even a partially appropriate schema might be called into use. This "foot in the door" strategy allowed access to some store of prior knowledge, however tangential it may have been to the topic of the text. Once the prior knowledge had been engaged, the reader might use it to assign importance to the text. In Example 2, a chemistry student read the anthropology text and found a phrase that was familiar. This excerpt is also an indication of how knowledge domains overlap. That is, every chemistry subject in the study was able to use the reference to "carbon-14 readings" in the anthropology text to help construct a meaning of the text.

(2) "'carbon-14 readings' rings a bell because of my work...and it shows that they're talking about aging."

Also encountered in the protocols were examples of readers assigning *unimportance* to text components. Here again, readers' prior knowledge relative to specific words and related concepts was often an important factor. (Example 3)

(3) "OK he's this is not important he's explaining the word migration which for me has no importance at all because I know what he's talking about."

In this excerpt, the reader is defining importance in terms of the a prior understanding of a specific word, and the amount of cognitive effort that must be expended to establish and store the word meaning.

Text Structure Cues Used In Assigning Importance

In lieu of knowledge for a specific content domain, expert readers used their knowledge of the structure of text, such as the repetition of words, phrases and concepts, to help them decide what was important. In most instances, it was necessary that the reader had enough prior knowledge to determine which concepts or words were related. (Example 4)

(4) "I guess this 'cultural discontinuity'...is what they want to try and explain...I again came in on the particular words...alright...'broken sequence' and 'cultural discontinuity'...they-uh...relate one to one another...in terms of a discontinuity meaning-uh-separation and then 'broken sequence' meaning separation so they're relating"

When at a loss for relating text to any relevant content domain prior knowledge, readers sometimes relied on the sheer number of occurrences of certain words to assign importance. (Example 5)

(5) "..OK y-I always see-y'know words or just the word 'point' ..'broad-point'.'Squibnocket point'..so.I'm just trying to understand what that means"
(Two sentences later, the subject noted:)
"there's that word 'points' again"

The Author As Determinant of Importance

In addition to using contextual, knowledge-based cues, and text structure cues, readers used a third type of strategy related to the author, to assign importance. That is, readers' perceptions of the author's intent, bias or style of argument were used as cues to help determine the assignment of importance.

For example, readers cued on the arguments that authors made, to try to determine any bias inherent in the text. With consideration of this bias, readers could make qualified assignments of importance. (Example 6)

(6) "they're trying to get me to accept uhm...some of these unmodified biochemicals because of their predominance.so they're trying to set my mind into their thinking. as to why these things are occurring"

The use of author related strategies for determining importance helped the reader because they added an additional criterion with which to judge importance. Thus, familiarity with the forms and uses of rhetoric permitted the reader to react not only to what was being said, but also to how it was being said. (Example 7)

(7) "this is apparently a very important sentence.so.because he's talking about evidence is 'only circumstantial'.but on the other hand he's trying to convince me that this circumstantial evidence is helping him to understand something better"

In summary, readers used three distinct sets of strategies to try to assign importance. These included focussing on the content of the text, as well as on its structure. Also, readers used strategies that were author-related. While there were instances where it was apparent that the reader was depending heavily on one type of strategy to assign importance, as when prior knowledge for the content domain was lacking, the most efficient use appeared to be when they were used in concert, providing multiple indicators of importance.

Readers' Goals and Importance Assignment

Readers' importance assignment processes were performed relative to the readers' goals. Specifically, importance was assigned depending on the type (or level) of the main idea statement the reader wanted to make for the text. A reader with relatively low knowledge for the text was sometimes

content with a quite brief main idea statement. Such a goal was set after readers considered how much they could bring to the text, and how taxed resources would be to come up with even an approximate main idea statement. (Example 8)

(8) "I don't really understand what's here but...what I do understand is that...he's explaining things that are not...relevant for what I'm looking for in the text-...so, although ...although if I would be studying this I would go back and read it again because it's obviously an important sentence I'm not gonna do it...if I I would be doing my research and looking only for certain things...so there is a difference...if-if I would be reading for one thing or the other"

As indicated by the previous excerpt, the assignment of importance was not only affected by the readers' content domain or text based prior knowledge, but also by the readers' goals and the level of performance they felt was appropriate to the task at hand.

Conditional Importance

Just as readers' goals might be tentative, so too were their assignments of importance. In such situations, a "back burner" (Johnston & Afflerbach, 1985) strategy was sometimes used in the determination of importance. (Example 9)

(9) "uhm..I'm not really sure if it's very important at this point..so I'm not gonna even worry about it...and later on if it seems like there was some important information in there I can go back and look at it again...but at this point I don't..I don't think it's very important..so I'm just gonna skim through it and just...put it in the back...so to speak"

The backburner strategy was valuable when reading unfamiliar text, as it allowed the reader to hypothesize about the importance of text components, and then read ahead to determine the accuracy of the hypothesis. Similarly, on familiar text, the backburner strategy was a process used to assign conditional importance when many potentially important pieces of information were competing for salience.

The verbal report data indicate that the expert readers used varied cues to assign importance: contextual, knowledge-based cues, text structure cues, and the author as determinant of importance. It was also noted that assignments of importance were made relative to the goals of the reader. Finally, expert readers used a conditional assignment of importance, when content domain prior knowledge was lacking, or when their cognitive resources were heavily taxed.

The verbal report data illustrate that each reader may have different standards for assigning importance in the same text, given the same instructions. The use of conditional importance assignments demonstrates that expert readers do not always have a set standard of importance. This flexibility of standards allowed expert readers to integrate text-based,

reader-based and author-influenced importance assignment with their goals.

Hypothesis Generation and Testing

This section includes a discussion of the cues used to develop hypotheses, the nature of readers' hypotheses, and modification and verification of hypotheses. Hypothesis generation, or prediction, was reported in all of the protocols. As previously discussed, an initial hypotheses of a main idea was one approach to main idea construction. However, hypothesis generation and testing processes were reported throughout the think-aloud protocols, and not only in the initial position. When initial hypotheses were generated, it remained for the readers to check the hypotheses against incoming information in the text. Expert readers made predictions using various text cues, including content domain knowledge, and text structure knowledge. Additionally, when readers detected that a previous hypothesis was not accurate or adequate, this was sometimes used as a cue for generation of a new hypothesis.

Cues used for hypothesis generation

Content domain knowledge was one cue used by readers to make predictions. Prior knowledge of specific words or phrases was often used to access appropriate schemata, with whose aid hypotheses were generated. (Example 10)

(10) "what I understand here is...that things are changing and that probably I'll probably read something new about the sedimentary organic compounds the words that I recognize here are 'sedimentary'...which I relate to what I know a bit of geomorphology...or geology"

Text structure knowledge, and knowledge of the ways which authors construct their arguments also aided readers in predicting. With this knowledge of text structure, readers made predictions about the text, even if content domain knowledge was lacking. (Example 11)

(11) "the key word there is 'yet', we may be now in the next two paragraphs, uh, or at least the next one...the final one's gonna be a summary of something...we're brought up to the present at the beginning of this new paragraph and then 'has not yet' leads me to believe we're going to talk about the future"

It is noted that the above protocol excerpt is devoid of mention of any content domain knowledge. Rather, the hypothesis appears to be based on the reader's text structure knowledge: a schema for historical exposition. Comprehension monitoring, or checking the status of earlier hypotheses also cued the reader to make further hypotheses. (Example 12)

(12) "this is not what I thought the paragraph was going to be about (notes inaccuracy of earlier hypothesis)...it looks as though again...this is an arti-

cle.about.we're gonna hear about a breakthrough coming up pretty soon" (new hypothesis)

What is hypothesized

In general, hypotheses directly addressed the meaning of the text (e.g., what would happen or what the text was about). Hypotheses about relative importance were generated as the reader tried to determine what parts of the text were to be included in a main idea statement, or to exclude parts of the text from further consideration. (Example 13)

(13) "well I don't know how to explain the word.but I guess I know what it is.and 'compounds' I didn't understand very well the word.but.my guess.right now.is that it's...it's...it's.many things put together somehow.so what I'll try to do.probably is try to understand it after reading.the rest of the text.because.it's obvious the word is very important"

The preceding excerpt also illustrates the relationship between importance assignment and hypothesis generation and testing, and how these skills can interact.

Modification of Hypotheses

When a prediction was accurate, it could remain intact through the reading of the text, until the main idea statement was given. If the prediction was flawed, it was often subject to modification. Occurrences of modification were indications that hypotheses were checked against incoming text information, that comprehension monitoring was being performed. Often, additional text information alerted the reader to the need to modify a previous prediction, and provided material with which to make the modification. (Example 14)

(14) "I don't understand very well what's going on..the only thing I know is that-...petroleum...starts from the very start.more or less.the way we find it.or there's.there's not many transformations"
(Reads next sentence)
"...so..so I relate my previous ideas-I thought before that
petroleum did not change..so I relate that idea to what they're saying now so apparently it does change through time"

The previous example of modification of hypotheses illustrates that having made hypotheses, expert readers actively monitored the accuracy of their hypotheses, and changed them when necessary.

Verification of Hypotheses

Verifications were statements relating the text just read to previously made hypotheses. For the reader, verification approved an hypothesis, and helped finalize the status of the hypothesis as it was included in the model of text the reader was building. (Example 15)

(15) "...the broadpoints evidently were there and then moved out..this may be a seasonal pattern (hypothesis)..cause this is the next thing I'm thinking of-..this..what sort of pattern can produce this?"
(Two paragraphs later the reader reported:)
"..which is one of the things I was thinking about earlier..it may have been seasonal" (verification of hypothesis)

The generation, modification and verification of readers' hypotheses have been considered in this section. The frequency of report, and apparent benefits of hypothesizing indicate the important role that hypothesis generation and testing plays for the expert reader in the main idea construction task.

Comprehension Monitoring

Comprehension monitoring served to integrate component reading processes within the limits of working memory, and to check that text was adequately understood. The monitoring took two general forms: the processes of evaluation and regulation (Baker & Brown, 1984). Evaluation was used to check and see that text was adequately understood, while regulation controlled the reader's working memory system. Previous excerpts in Study Three illustrated the interaction of comprehension monitoring with hypothesis generation and testing, and importance assignment.

Evaluation

Evaluation was often reported at the end meaning units: at the end of sentences, and at other breaks in text, including commas, colons and semicolons. (Example 16)

(16) (Finishes reading sentence)
"...I have to read it again"
(re-reads sentence)
"OK now that the second time that seemed to be more...easy to it seems that-..the recall..or the establishment of what that sentence's saying is better the second time..."

In addition to evaluation at the end of meaning units, readers also reported evaluation at points of breakdown in comprehension. (Example 17)

(17) "...wait-'post' means after..after deposits they were changed.....I'm re-reading it cause it's too long..."

Evaluation was important not only for checking the understanding of text as it was read, but also for the maintenance of that understanding, as in situations where comprehension difficulties were encountered with incoming text. In such instances, the reader had to divide workspace to deal with any problem at hand, and also to "hang on to" the parts of text that had already been comprehended. (Example 18)

(18) "OK...now these two words 'living organisms' make me think that maybe I'm losing something...from the previous chapters...uh previous sentences...so I'm gonna go back to see if I lost something important"

In some protocols, the interaction of evaluative and regulative processes was observed, in which the reader reported using both to comprehend the text and manage cognitive resources. (Example 19)

(19) "...OK this uh....OK-this is fairly...understandable and understood...uh sentence uh-and.....the processes that are active right now are not ones of...of-uh...translation but...of storage...because this sentence is...understandable"

Because the comprehension problems noted through evaluation often warranted immediate, implementation of fix-up strategies, there were sometimes detailed reports of entire sequences of these strategies. Examination of the protocols indicates that expert readers performed problem solving routines to try to resolve the problem that had been detected. (Example 20)

(20) "...however' OK at the moment this sentence doesn't make sense (detection of problem)...because-uh it seems that I have misread it (specification of problem)...so I'll re-read it..." (fix-up strategy proposed; re-reads; fix-up strategy initiated)"again the key-the key uncertainty is in the usage of the word 'however' (detailed specification of problem)...so I wanna dwell on that word because of the word because of it's combination with the word 'since' ...uh...(further specification of problem) (re-reads)"...OK so that-that-that makes sense when you use the words 'however' and 'since' in the proper uh usage OK..." (effectiveness of fix-up strategy is evaluated)

Regulation

Regulation was performed where there was perceived failure or perceived imminent failure of the text processing system. Regulation processes were performed to maintain or increase efficiency of the reader's discourse processing system, and readers took two general approaches to regulation. The first was reactive, and was implemented after a problem with comprehension was detected. (Example 21)

(21) "...the two sentences are very I think too compact in terms of they're trying to get too much information out at one time and it's kind of overloading the old...senses right now the way I deal with it is going back and re-reading the first sentence after reading through the second sentence again and trying to...get the flow uhm...get some continuity out of what they're trying to say..."

A second approach to regulation was proactive, where an anticipated problem with comprehension caused the reader to change strategies, such as the slowing the rate of reading. (Example 22)

(22) "so what they're just saying is we don't...it-it's confusing this-this next part...so uhm I feel like I have to walk through it slower-it's like mud...walking through...y'know?"

Comprehension monitoring was an important skill which helped the readers evaluate their progress towards constructing a main idea statement. Comprehension monitoring also helped readers regulate their text processing systems, and avoid situations of "thrashing" (Britton, Glynn & Smith, 1985) where there are too many things going on at once, and not enough cognitive resources to deal with them.

Reader attributions and affective interaction with text

Studies Two and Three focussed on the cognitive processes used by expert readers to construct main idea statements. Expert readers' protocols also contained reports related to readers' attributions for their performance, and to readers' affective interaction with the text. The combination of reports related to affect, attribution, and cognition can make difficult the categorization of cognitive processes. However, it also allows for consideration of aspects of reading that are not adequately considered in most cognitive models of reading. In the following section, readers' attributions and affective interactions will be briefly considered. It is hoped that the excerpts provided will serve to illustrate the potential power of reader attributions, and the influence of readers' affective interaction with text on what is ultimately comprehended.

Because the main idea construction task is difficult, the expert readers' text processing systems were often operating near full capacity, or on the verge of failure. When difficulties were encountered in the text, the experts sometimes verbalized their attributions for performance. In the following excerpt, the reader attributes his errant hypothesis to the author's ability as a writer. (Example 23)

(23) "well the paragraph ends the second half of the paragraph with.. about various details of some earlier work which. I..at first.. this is not what I thought the paragraph was going to be about.. uh I I would fault the author for..for starting us with a two sentences that seem to direct you to historical developments and then concentrate on uh.. other stuff"

In the above excerpt, the reader fails to take responsibility for the errant hypothesis. Rather, an external attribution is made. In contrast, readers also made internal attributions for their performance, such as the failure to understand a verb phrase. Accompanying this internal attribution was the prolonged effort to make sure the verb phrase was understood. (Example 24)

(24) "I read that wrong somehow.. uhm I'm trying to figure out where the verb is.. 'even cap' 'cap' must be the verb but I don't know.. recognize that.. all of a sudden I'm thrown off.. OK the main point is that they're trying to figure out.. uhm.. uhm the people that had this had this technology of broadpoint.. whatever it is doesn't matter I know that it's a technology.. uhm they they wanna know whether they what relationship they had with the people that that didn't have the assemblage that were already there and it says that they it gives uhm there is evidence for people already being there but.. uhm.. oh" uh I'm

trying to figure out what this 'cap' means.and I think...maybe...see I'm not an archeologist-but I think.uhm.'cap' maybe means.it-are in the-the strata-they're on the top strata"

Readers' attribution systems can exert a powerful influence on reading performance, including a proclivity for persisting, or giving up, in the face of difficulty (e.g. Abramson, Garber, & Seligman, 1982; Johnston & Winograd, 1985). As the readers for this study were experts, it is important to consider the potential influence that attributions might have with younger, less competent readers. Research which further examines readers' attributions and their relation to reading performance is needed.

While current models of the reading process make note of affect and reading (cf. van Dijk & Kintsch, 1983), much needs to be learned about the influence of affect on cognition, and on readers' persistence at the task of reading. The think aloud protocols provided examples of affective interaction with the text, content of the text, or perceived author of the text. At times, readers reported on what seemed a positive engagement with the text. (Example 25)

(25) "at any rate.the second sentence...this will be fun!.this-uh this culture is so weird...they really are...they are a really interesting group"

In other instances, an affective reaction might cause the reader to question the value of the text being read, and the wisdom of investing any time reading such a text. Additionally, if the reader had a negative reaction to the author's rhetorical devices, the reader might feel that further investment of time and effort for reading the text was not warranted.

(27) "OK...this is not true.this fifth criteria makes me laugh..... it makes me laugh because.when he says that.uh.the appearance of certain things cannot be accounted for by any other hypothesis... he's using negative evidence to explain something"

The verbal report data hint at the influence that reader affect may have on reading. The data also help in the formation of questions which might be addressed by future research: How do readers' feelings for *what* is being read influence *how* it is being read? What are the cognitive bases for affective interaction with text? How do positive or negative affective interactions with text influence comprehension? How does readers' prior knowledge influence affective interaction with text?

Discussion

The protocol excerpts presented in Study Three provide the cognitive context in which the main idea construction processes were performed, as it allows the examination of related comprehension processes. The selected samples of verbal reports provide a converging source of data for the role that importance assignment, hypothesis testing, and comprehension moni-

toring play in comprehension, and particularly main idea construction. Additionally, readers' affect and attributions were considered.

The verbal reports provided information related to importance assignment. As indicated by the protocol excerpts, cues related to domain specific vocabulary knowledge were often used by the readers to assign importance, and unimportance. Additionally, the readers used their knowledge of text structure to help in assigning importance. These findings support current proposals of how importance is assigned in text (e.g., van Dijk, 1979; Winograd, 1984). However, also reported in the protocols were importance assignment strategies that need to be further investigated. Some readers constructed an author, around whom they constructed a set of intentions. These were used to support decisions about the importance of text elements. Readers often assigned importance based on their perception of the author and the perceived author's purpose for writing. This strategy indicated an interaction between not only the reader and the text, but between the reader, the text, and the author.

Readers reported importance assignment relative to their goals. All readers had as their goal the construction of a main idea statement. However, the readers determined the level, or thoroughness of the main idea statement, and this was reflected in the levels of importance assignment. Also reported in the protocols was conditional importance assignment which gave the readers flexibility, so that they did not over-commit to an assignment of importance. As readers' goals were sometimes conditional (when readers were not sure what level main idea statement to attempt), so too were their assignments of importance.

In posing hypotheses, readers often used text cues to engage appropriate prior knowledge, and used this to predict what text was about. Thus, the verbal report data support models of reading which emphasize prediction and hypothesis testing (Collins & Smith, 1982; Goodman, 1976). A benefit of hypothesis testing was that through the posing of an hypothesis, the reader was limiting the problem space to be dealt with (Greeno, 1978), and engaging prior knowledge that was appropriate to operations within that problem space. In many of the protocols, it was also apparent that expert readers carefully controlled hypotheses (Bruce & Rubin, 1984), and often attempted to hypothesize about an optimal amount of the text. That is, if the reader felt sure about the text topic, a large scale hypothesis might be posed. In situations where the reader was less sure of the topic, hypotheses addressed smaller portions of the text.

Readers generated hypotheses using a variety of cues, and directed the hypotheses to various facets of the text. While there was great variation in the frequency of the reporting of hypothesizing behaviors, all of the subjects reported using them. Readers with low prior knowledge were often able to pick cues in text structure, or embedded in the relatively unfamiliar text, to keep the hypothesis generation and testing an important part of comprehension. Thus, low prior knowledge for the content domain of a text was not always problematic for the expert reader, at least in the realm

of hypothesizing behaviors. These readers appeared to use their textual schemata (Anderson, Pichert & Shirey, 1983) when content schemata were lacking, or poorly developed.

Many researchers have stressed the importance of comprehension monitoring for efficient reading (e.g., Baker & Brown, 1984; Britton, Glynn & Smith, 1985; Collins & Smith, 1982). The expert readers' reports of monitoring offer support for this view. Indeed, it is hard to imagine the readers' successful performance in this study without monitoring skills. Collins and Smith also propose that comprehension monitoring occurs at the word level, and ranges to to include the understanding of entire texts. This is supported by the verbal report data, as readers were quite flexible in application of local and global monitoring strategies.

Finally, it should be again noted that subjects were not asked to report importance assignment, hypothesis testing and comprehension monitoring, except as they were part of main idea construction. Thus, the presence of such reports, and the variety of instances in which they were used may be taken as indication of the importance of these related processes. Future research should investigate readers' use of these important comprehension skills, through variation in tasks, and instructions to subjects.

Methodological Note

Because of the general nature of the instructions to subjects in Studies Two and Three, the range of comprehension and reading-related processes reported was broad. This provided reports of the context in which main ideas were constructed. Had subjects received more specific instructions on what was to be reported, this might have reduced the reports of important, related behaviors. The use of naive subjects (in regards to the literature on text processing, comprehension, and cognitive psychology) severely limits the possibility that subjects were reporting what they thought the researcher wanted to hear: the subjects had no prior knowledge from which to construct such accounts.

GENERAL CONCLUSIONS

The verbal report data provided both a quantitative and qualitative perspective from which to observe the effect of prior knowledge on expert readers' main idea construction processes. Study One investigated the latencies of verbal reports given under different prompt conditions, and found no significant differences in the latencies. Thus, it was concluded that the use of prompts to elicit verbal report data for Studies Two and Three did not influence the nature of the verbal reports.

Study Two examined the main idea construction processes. Four of these were de-automated processes: initial hypothesis, draft and revise, topic/comment, and listing, while the fifth main idea construction process was automatic. Examples of the construction processes and rules for their use were presented. Each construction process was considered in terms of its use under conditions of high and low prior knowledge. The use of the construction processes supports the findings of Johnston and Afflerbach (1985; Afflerbach & Johnston, 1986), and serves to refine Brown and Day's (1983) summarization rule of construction. Similarly, the findings refine van Dijk and Kintsch' model of discourse processing (1983), which proposes that main idea construction is a unique, elemental process, and also proposes that comprehension processes that are de-automated are of limited value.

The interaction between main idea construction process and text familiarity demonstrates that prior knowledge has a significant effect on the processes used by the expert readers. These prior knowledge effects were considered in terms of text comprehension (e.g., van Dijk & Kintsch, 1983), and information processing (e.g., Baddeley & Hitch, 1974) models. High prior knowledge for a text encourages automatic processing, while low prior knowledge often requires de-automated, deliberate processing. Because of expert readers' skill with related reading processes, especially comprehension monitoring, the use of conscious, deliberate processes did not prove an insurmountable obstacle to the expert readers.

Study Three examined the processes related to main idea construction: importance assignment, hypothesis testing, and comprehension monitoring. There was no mention of these processes in the instructions to sub-

jects, or in the pre-experiment training tasks. Thus, it is important to note their occurrence in the process of constructing main idea statements. Also discussed was the importance of the related strategies in the overall scheme of main idea construction. Protocol excerpts were used to illustrate experts' use of the related strategies.

The think aloud protocols allowed for the consideration of reader attributions, and the affective lives of readers. While this study focussed on the cognitive processes of main idea construction, verbal reports involving affect and attributions were apparent in every protocol. Subjects often reported their emotional response to their performance, the topic of the text, or the style of the perceived author. The reports of affect underline the fact that reading involves more than the cognitive processing of information. Rather, readers often react to what they read, and these reactions may influence what is remembered, what is ignored, and the effort that the reader puts into the task at hand. Reports of readers' attributions illustrated that even expert readers vary in their willingness to take responsibility for relative success or failure on the task at hand. Future research should explore the role of affect in reading, and how reader attributions can influence the reading of a text.

LIMITATIONS

There are several limitations on the findings of these studies. The texts used in the study appeared in professional journals, were of similar length, and were originally in the literature review sections of the articles they were taken from. However, no structural analysis of the texts was performed. Thus, the possible effects of text structure on main idea construction processes were not investigated, except as verbal reports related to text structure were considered. Another concern related to the texts is that while they were naturally occurring, they were taken from the middle of articles and were presented to the subjects without titles or headings. Thus, there is a tradeoff in the ecological validity of the study. The portions of the articles which were used in the study were not re-written or otherwise changed. However, these portions were presented outside of the context of the entire article in which they originally appeared. It is important that future research examines the interaction between main idea construction process type and text structure and text genre. Furthermore, it is important that the appropriateness of main idea statements as a measure of comprehension for different types of texts and reading situations be explored. As noted by Rosenblatt (1978), there are many different purposes for reading, ranging from efferent to aesthetic, and the interaction of reader, text, and purpose for reading is important to consider.

This study did not determine the efficacy of the main idea construction processes in relation to one another, or evaluate the accuracy of the main idea statements, as the intent was to examine the processes themselves. While the readers supplied what the researcher felt were adequate main idea statements (meeting the requirement of having a topic and comment, and reflecting the contents of the paragraph or text), more formal investigation of the appropriateness of main idea statements is necessary before questions concerning the superiority of one main idea construction process over another, under specific conditions, might be offered. This seems an important area to address in future research.

A further possible limitation is that the expert readers were reading aloud – certainly not their normal mode of reading. This is one of the tradeoffs required by the design of the study. Subjects were encouraged to

report on their processes wherever and whenever they could. Many reports were given in mid-sentence. Had subjects been reading silently, it would have been difficult, and in many cases impossible to determine where in the text they were while performing the reported processes. With the practice think-aloud sessions prior to the experiment, subjects seemed to be comfortable with the oral reading task.

While the focus of this paper has been on the five main idea construction processes, verbal report protocols indicated that there are substantial individual differences in the ways that expert readers progress to the point where main idea construction begins. All subjects received the same instructions. However, differences in goal formation (and level of goal), attributions, affective reactions, and related strategy use were notable in the protocols.

Finally, identifying the main idea construction processes, and related processes in the verbal reports was a difficult task. Hence, the establishment of acceptable interrater reliabilities for the verbal reports proved challenging. It is noted that the coders of data for this study have been working with verbal report data for over three years, and that the reliabilities attained for the classification of processes reported in the protocols may well be a function of this time and training spent previously with verbal report data.

EDUCATIONAL IMPLICATIONS

The data indicated that even for expert readers, main idea construction can be a difficult, potentially overwhelming task. It is not suggested that the texts encountered in school are of a similar level of difficulty as the ones in this study. However, relative to the expertise of the reader, there may be a reasonable parallel in terms of task difficulty. Thus, it seems important to acknowledge the potential difficulty of the main idea construction task. Currently, there is a failure in many basal reader series and comprehension instruction textbooks to distinguish between the processes of selecting, and constructing main idea statements (Hare & Milligan, 1984; Winograd & Brennan, 1983). Construction is the more difficult task (Brown & Day, 1983), and instruction should reflect this.

It may be at this point premature to consider immediate implications of these studies for instruction. However, a potential contribution of expert readers' verbal report data is that they may serve as explicit instructional models. For the developing reader, a teacher could model main idea construction processes distilled from the think-aloud protocols of experts. Such explicit modelling has proven effective in training studies which "foster" comprehension skills (Palincsar & Brown, 1984). As noted earlier, training in use of other summarization rules has led to many students' improvement in the ability to summarize (Brown & Day, 1983). This study provides examples of experts' strategies for constructing main ideas, assigning importance, generating hypotheses, and monitoring comprehension. These might eventually be incorporated into an instructional sequence for teaching comprehension strategies.

Finally, because the main idea construction process often required the use of non-automated, deliberate strategies, students should be allowed sufficient time to perform the task. Expert readers successfully constructed main idea statements because they had the appropriate skills, and sufficient time to use them.

APPENDIX A
Texts Used in the Experiment

Anthropology text

The array of traits identified with the broadpoint users is easily distinguished from that of preceding and even contemporary cultures in the Northeast. But it remains to be determined how or in what ways the people using the broadpoints integrated with resident groups, for recent excavation data give convincing evidence in support of the theory that the broadpoint people entered an already occupied region. Broadpoint assemblages even cap narrow-stemmed point levels at several sites in the Northeast, including Sylvan Lake, New York; Martha's Vineyard, Massachusetts; the Neville site, New Hampshire; and along the Maine coast.

Give main idea statement for paragraph

Both Dincauze and Ritchie, who have favored the view that the narrow-stemmed point peoples may have continued to co-exist with the broadpoint groups, suggest that perhaps each had a somewhat different economic focus which permitted them to do so. While the evidence is so far only circumstantial and has not yet been corroborated by good carbon-14 readings, one pri ary testament in support of the hypothesis is the resumption of the narrow Squibnocket points above a broadpoint level on Martha's Vineyard. One could also consider the emergence of what may be termed a "narrow broadpoint" form several centuries later in parts of the Northeast. It seems possible that these Orient and Drybrook fishtail points may represent a survival and merger of the narrow-stemmed point tradition with the broadpoint. This possibility is a topic for further study and support, however, since the genetic blending of cultures and their traits is still a much debated question.

Give main idea statement for paragraph

At any rate, the appearance of the broadpoints seems to represent an abrupt cultural discontinuity. This broken sequence could be accounted for

either by trait diffusion or by migration (the actual movement of people into the area). The migration hypothesis is favored in this instance, although no major population movement is necessarily implied.

Give main idea statement for paragraph

The broadpoint cultural assemblage represents an entire cluster of traits and certainly involves lifeways that were fundamentally distinct from those they preceded and presumably displaced. The interrupted archeological sequence in the North, particularly at Sylvan Lake, Martha's Vineyard, Nevelle, and in Maine, add more tangible proof of this break. Furthermore, the invocation of a migration hypothesis is justifiable, since the theory does meet the five criteria established by Rouse: first, the assemblage is an intrusive unit, as suggested by the just-cited evidence, which includes interrupted cultural sequences; second, a homeland for the manifestation has been located in the southern Coastal Plain; third, all occurrences of the broadpoint units appear within a relatively short time span, taking into account the considerable distance involved; fourth, favorable conditions for occupation in the recipient areas included climate, riverine conditions, fish, and other fauna in abundance; and fifth, the wholesale appearance of entire cultural units across a wide area cannot be directly accounted for by any other hypothesis. While migration is the preferred explanation, nonetheless a relatively small number of mobile groups could have been responsible for this manifestation.

Give main idea statement for paragraph

It is legitimate to further characterize the broadpoint appearance as a major archeological horizon marker for the eastern seaboard. In the terms of Willey and Phillips, a horizon is "a primarily spatial continuity represented by cultural traits and assemblages whose nature and mode of occurrence permit the assumption of a broad and rapid spread". That a quick expansion of the broadpoint-using peoples took place is indicated by the narrow range of available radiocarbon dates, along with correspondingly wide areal distribution of components. Once established, the broadpoint horizon developed as a "whole cultural pattern or tradition" in its own right by persisting and evolving over an expansive region for 500 to 1000 years.

Give main idea statement for paragraph
Give main idea statement for selection

Note: The author would like to thank the editor of *Journal of Anthropological Research* and the author of this article for permission to reprint this excerpt.

44

Chemistry text

There have been changes in our views on the origin of sedimentary organic compounds. Earlier, these were considered as the random transformation products of biological source materials. Treibs' work and much of the succeeding effort in this field have revealed identifiable structures of biological origin in ancient geological specimens. In many instances, seemingly unaltered biochemicals have been isolated, even from Precambrian sediments. Examples are the straight-chain, iso, anteiso and isoprenoid hydrocarbons and the corresponding fatty acids, the amino acids and certain carbohydrates. In other chemical fossils, the biochemical architecture remains recognizable, but peripheral groups have been altered, polar substituents have been reduced or eliminated and the overall size of the molecules may have been changed.

Give main idea statement for paragraph

The abundance and obvious importance of these chemical fossils have suggested to some that the fossil organic matter consists largely, if not exclusively, of biochemicals that have been preserved without or with minimal postdepositional change. This led to a complete reversal in the theories of the origin of petroleum: crude oil initially thought to be an unexplainable product of postdepositional randomization now was considered fully explained as an accumulation product of biologically derived hydrocarbons.

Give main idea statement for paragraph

Present knowledge no longer justifies this extreme view. Research on the constitution of crude oil and of oil shales has revealed severely altered biochemicals and numerous structures that occur neither in living organisms nor in recent sediments. Among these are the light hydrocarbons, the substituted benzenes and the many substituted multiring aromatic and hetero-compounds of petroleum. Also, crude oil and sediments contain polymers (asphaltenes, kerogens) of a type not found in living organisms. There seems to be fairly general agreement now that the fossil organic matter is a mixture of biochemicals, surviving with little or no modification, together with compounds that have been altered severely, with or without retention of a recognizable nucleus of their original biochemical architecture. Although it is agreed that unaltered and heavily transformed organic compounds occur simultaneously in ancient sediments, agreement on the extent and importance of postdepositional chemical transformation has not yet been reached.

Give main idea statement for paragraph

In fact, this is one of the principal areas of disagreement among petroleum geochemists. The relative predominance in crude oil of steranes, triterpanes and phytol-derived isoprenoid hydrocarbons and acids make a strong point for the survival of relatively unmodified biochemicals. On the other hand, the overwhelming complexity of the remaining petroleum constituents, the existence of a vast array of chlorophyll derivatives and the nature of the polymeric fraction, which remains largely in the source rocks, make an equally strong point for extensive chemical modification during the process of petroleum formation.

Give main idea statement for paragraph

The gradual and at least partial transformation of biochemicals in the subsurface does not represent an irreversible trend. This further complicates the assessment of the relative importance of subsurface chemical reactions. Buried sediments or deep oil deposits may again be exposed to recent bacterial populations when uplifting and erosion bring the strata within reach of meteoric waters. Bacterial activity at that late stage leads to deep changes in crude oil compositon. In terms of the overall material balance, this leads to a loss of organic matter through conversion to carbon dioxide. However, new biochemical metabolites may be formed and introduced into the oil, the formation waters and the sediments. These compounds, which include hydrocarbons and acids, may be entirely different from the metabolites which are formed during the early diagenetic history, when oil as a substrate for bacterial growth is not yet present. Possibly, this could serve as a basis for recognizing the extent of bacterial reworking at a late diagenetic stage.

Give main idea statement for paragraph
Give main idea statement for selection

Note: The author would like to thank the editor of *Pure and Applied Chemistry* and the author of this article for permission to reprint this excerpt.

APPENDIX B
Instructions to Subjects

We would like you to think aloud into the tape recorder, expressing the processes you use in trying to arrive at a main idea statement for each paragraph, and a final main idea statement at the end of each selection. The red markers have been placed between sentences to remind you to think aloud. When you come to a marker, tell us what you are doing. However, do not wait for the marker if you have something to say! The more you tell us about what you are doing while reading the paragraphs, and especially while making the summary statements, the better. We are interested in the processes involved in constructing main idea statements, so please be sure to include all that you can in terms of verbalizing the processes. Also, for main ideas, try to avoid statements like "It's about fish," or "It has to do with science," for final summary statements. (You can include such statements as they occur spontaneously in "thinking aloud").

Note: Some of the passages have been constructed in a manner which should make them very difficult to summarize – we intended this. So don't worry if a passage seems particularly dense or obscure, for it probably is!

APPENDIX C
Verbal Report Transcription Method

Following is a sample excerpt of the anthropology text, the corresponding verbal report, and explanation of verbal report transcription scheme.

READS: While migration is the preferred explanation, nonetheless a relatively small number of groups could have been responsible for this manifestation.

1 2 3 4
"OK...now he's saying 'small number of groups'..and there ..wait..I remember that from the first sen-paragraph"
5 6 7

1. Verbal report excerpts are enclosed with double quotation marks.
2. Ellipses, appearing between words, represent one second of pause time. In this instance, three seconds elapsed between the verbalizations "OK" and "now".
3. Quotes from text receive single quotation marks.
4. Words underlined reflect their spoken emphasis in the verbal report.
5. Normal spacing between words indicates that they were spoken at a regular rate.
6. A hyphen indicates that no pause time occurred between words or parts of words.
7. No punctuation appears at the end of the verbal report excerpt, except for exclamation points and question marks.

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